**AS Unit 1: Basic Biochemistry and Cell Organisation**

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| Name: | Date: |

**Topic 1.6 Nucleic Acids – Page 1**

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| **1.6 Nucleic Acids**  1. The components of a nucleotide are pentose sugar, phosphate plus organic base which contains nitrogen  2. Nucleotide bases are purines or pyrimidines, linked by condensation reactions to form polymers RNA and DNA which can be represented in symbolic form  3. DNA consists of two chains linked via the base pairs by hydrogen bonds to form a double helix  4. The base pairs are C G and A T but in RNA thymine is replaced by uracil  5. DNA has two major functions replication in dividing cells and carrying the information for protein synthesis in all cells.  6. Replication allows accurate copying of DNA for cell division. (no details of Meselson-Stahl required) |

l. Introduction to Nucleic Acids

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|  |  | Completed |
| 1. | Go through the PowerPoint on Nucleic Acids |  |
| 2. | Read the following:   * Rowlands p * Toole p109-103 * Hand out Nucleic Acids * 1.6 Notes and complete questions |  |
| 3. | Complete the quiz at the end |  |

Start of topic checklist for NUCLEIC ACIDS

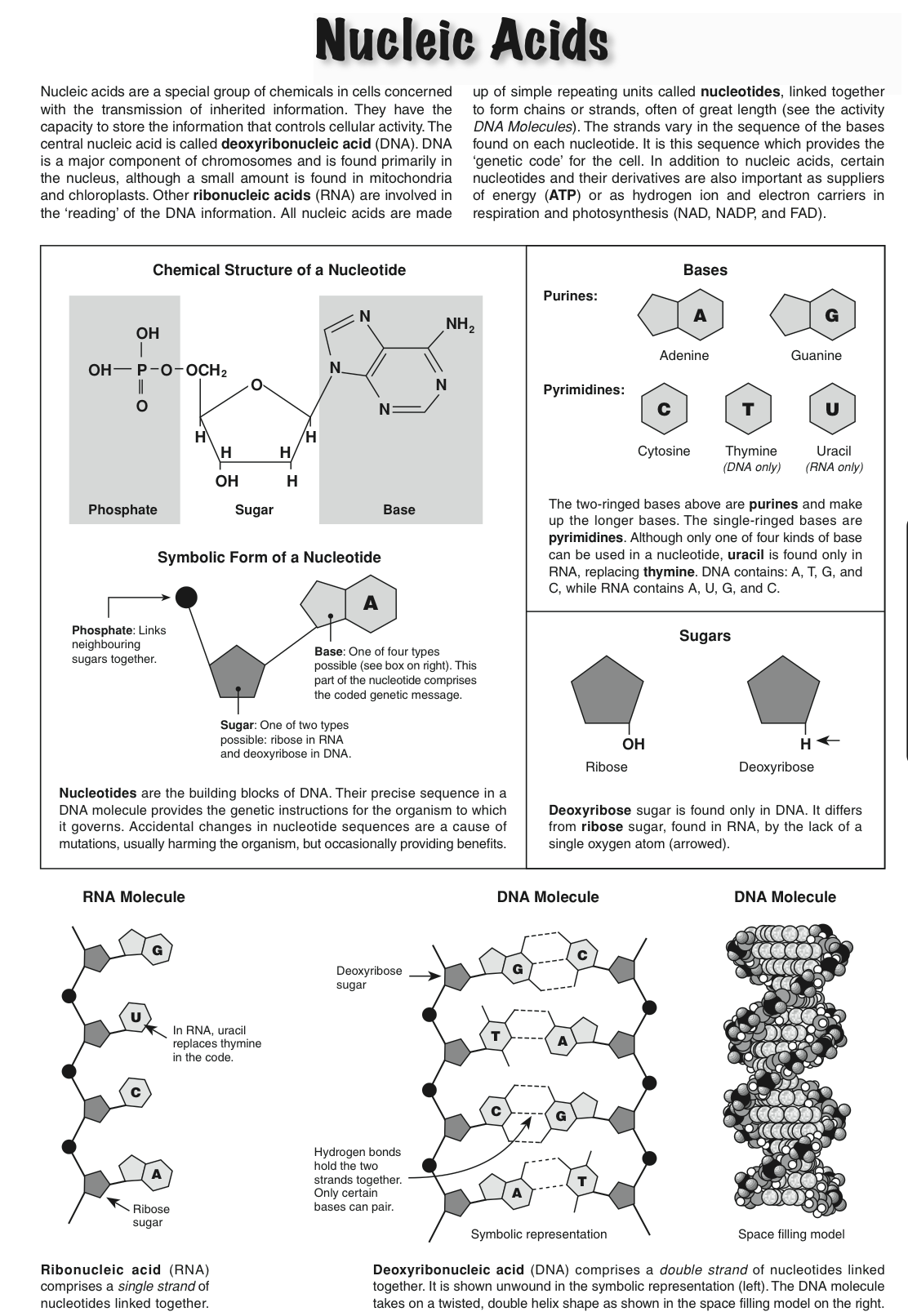
Tick as appropriate:

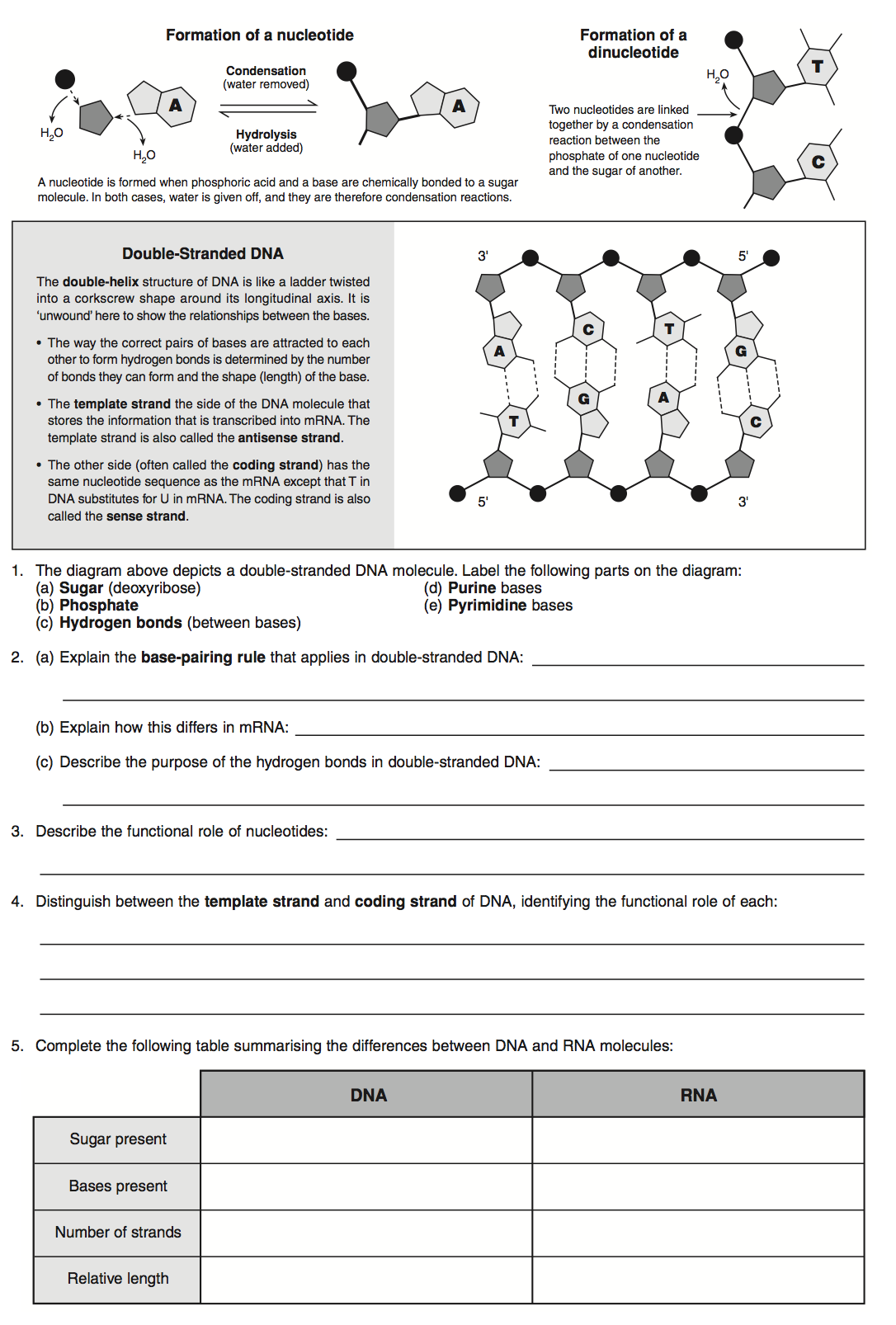
RED : I do not know about this

AMBER: I have heard about this but have not learned this yet. I am unsure on this.

GREEN: I have heard about this and I have learned this. I am confident about this.

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| Topic | RED | AMBER | GREEN |
| 1. The components of a nucleotide are pentose sugar, phosphate plus organic base which contains nitrogen. |  |  |  |
| 1. Nucleotide bases are purines or pyrimidines, linked by condensation reactions to form polymers, RNA and DNA, which can be represented in symbolic form. |  |  |  |
| 1. DNA consists of two chains linked via the base pairs, by hydrogen bonds, to form a double helix. |  |  |  |
| 1. The base pairs are C-G and A –T but in RNA thymine is replaced by uracil. |  |  |  |
| 1. DNA has two major functions: replication, in dividing cells, and carrying the information for protein synthesis in all cells. |  |  |  |
| 1. Replication allows accurate copying of DNA for cell division. |  |  |  |





A **nucleotide** is the basic unit or monomer from which nucleic acids are formed.

The nucleotide of DNA consists of three parts:

* Deoxyribose (a pentose sugar)

What does ‘a pentose sugar’ mean?

* Phosphate group (H3PO4)

What three elements does a phosphate group contain?

* An organic nitrogen containing base.

If the base is described as ‘organic’ and nitrogen containing, what 2 elements must it contain?

The three shapes shown by each of the parts are usually used when drawing a simple diagram of DNA structure.

The deoxyribose sugar, phosphate group and organic base are joined together as shown below to form a nucleotide.

**A DNA nucleotide.**

Label the three parts of the DNA nucleotide shown above.

All DNA nucleotides contain a phosphate group, deoxyribose sugar and organic base **but** they do not all have the same base. Four different bases are found **adenine**, **thymine**, **cytosine** and **guanine**.

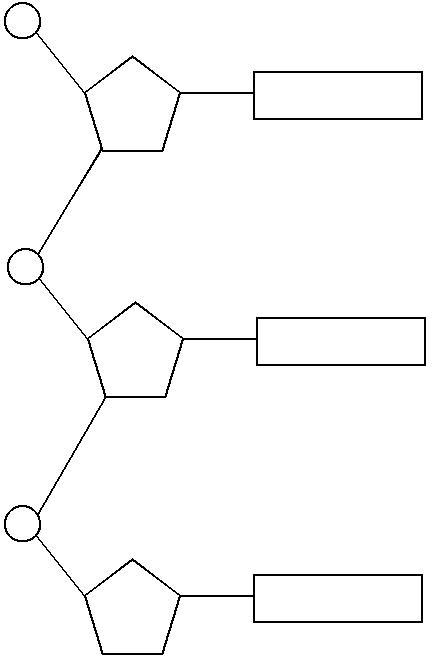
The names of these four bases are usually abbreviated to the letters A, T, C and G. These 4 letters form the bases of the genetic code.

Pick one of the four bases and draw a nucleotide (using the shapes as described above) with that base attached in the box below:

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DNA nucleotides can be joined together to from a polymer, a polynucleotide.

This reaction produces water and is known as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ reaction.

Below is a simple diagram showing the polynucleotide structure of a single strand of DNA.

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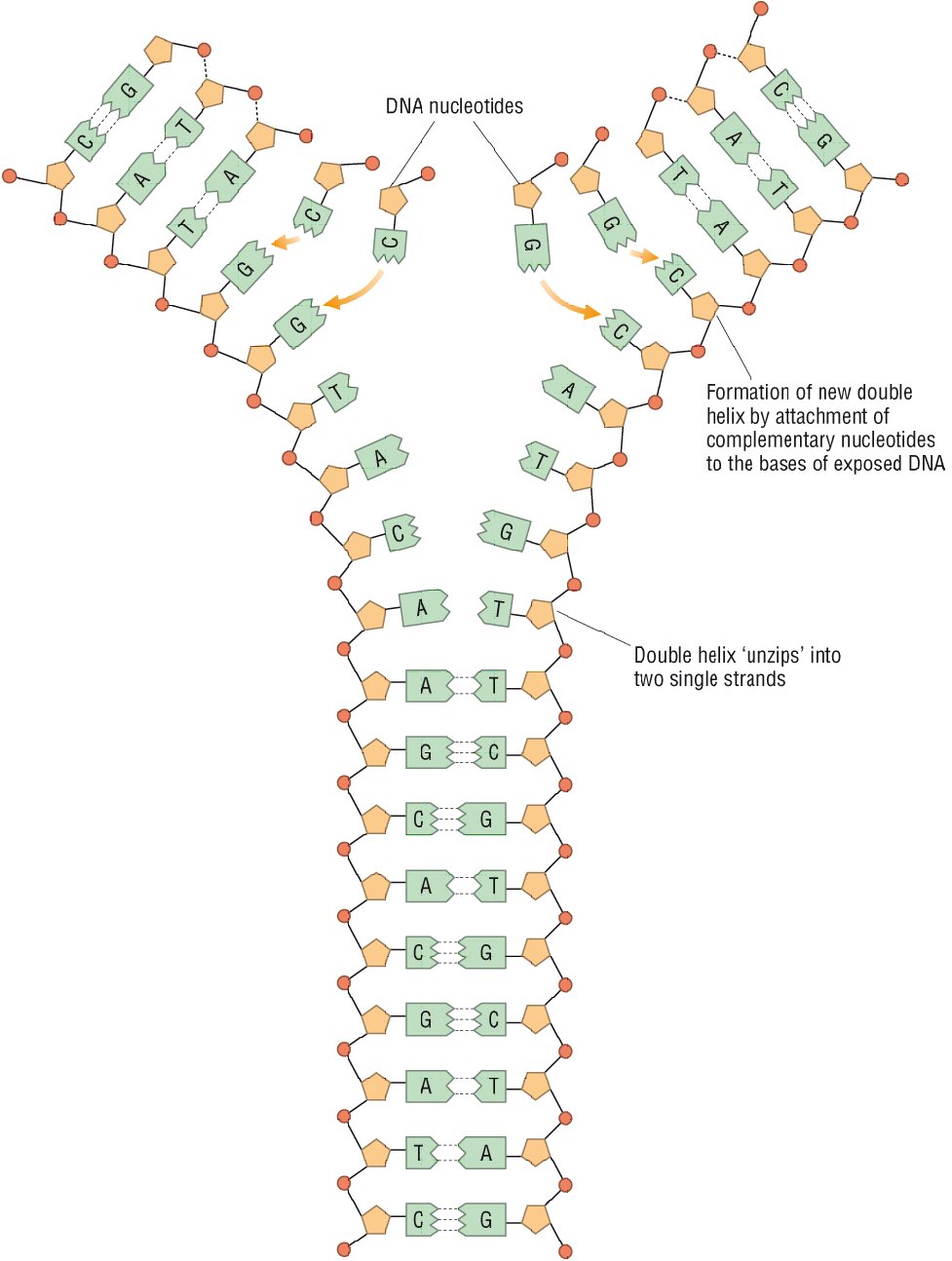
Between which 2 parts of the nucleotide (monomer) have bonds been made in order to form a polymer molecule?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A covalent bond forms between these 2 parts. What does a covalent bond mean?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Label all the parts on the diagram where there is a covalent bond.

We describe the structure as having a ‘sugar-phosphate backbone’. This sugar phosphate backbone is very strong, it is a lot easier to break the hydrogen bonds holding the base pairs together in DNA, than it is the bonds between the sugar and phosphate group.

The structure of DNA is in fact a ‘double helix’, with two strands of polynucleotides (polymers of nucleotides) antiparallel to one another (one runs in one direction and the other in the opposite direction), these two strands are then twisted to form a helix. The two strands are held together by hydrogen bonds that form between the organic nitrogen containing bases. This creates an effect that looks like a ladder.

Hydrogen bonds can only form between adenine and thymine; and between guanine and cytosine.

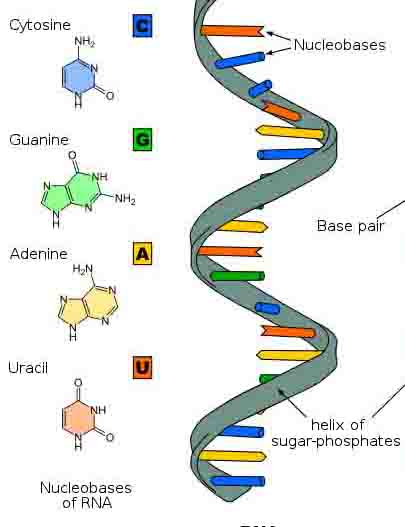
This is known as **complimentary base pairing**.

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| http://cronodon.com/images/DNA_Structure.jpg |

On the diagram above label the following;

* A deoxyribose sugar.
* A nitrogenous base.
* A hydrogen bond.
* The sugar-phosphate backbone.

**DNA** has **two major functions** – it needs to be replicated during the S stage of interphase in preparation for mitosis or meiosis **and** contains genes, genes contain the information for synthesizing proteins.

**RNA.**

Cells also contain another polynucleotide called RNA (Ribonucleic acid). It has a number of similarities and a number of differences with DNA. Look at the diagram to the right and see if you can list some of the similarities and differences in the table below.

|  |  |
| --- | --- |
| **Differences** | |
| **DNA** | **RNA** |
|  |  |
|  |  |
|  |  |
| **Similarities** | |
|  | |
|  | |
|  | |

There are three types of RNA. Messenger RNA (mRNA), Ribosomal RNA (rRNA) and Transfer RNA (tRNA). Find out the functions of each type.

|  |  |
| --- | --- |
| **Type of RNA** | **Function** |
| mRNA |  |
| tRNA |  |
| rRNA |  |

Identify and label the three types of RNA below:

|  |  |  |
| --- | --- | --- |
| Macintosh HD:Users:sarahpreston:Desktop:Screen Shot 2014-11-06 at 11.31.37.png | Macintosh HD:Users:sarahpreston:Desktop:Screen Shot 2014-11-06 at 11.31.43.png | Macintosh HD:Users:sarahpreston:Desktop:Screen Shot 2014-11-06 at 11.31.31.png |

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| 6 |

Organic bases are put into categories. Adenine and guanine are **purine** bases and thymine and cytosine are **pyrimidine** bases.

Look at the diagram on the previous page.

How many carbon ring structures do pyrimidine bases contain?

How many carbon ring structures do purine bases contain?

This means that **only a pyrimidine paired with a purine** will fit in the space between the sugar phosphate backbones.

Therefore adenine always pairs with \_\_\_\_\_\_\_\_\_\_\_\_\_

And guanine always pairs with\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Looking at the diagram state how many **hydrogen bonds** form between:

Adenine and Thymine \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Guanine and cytosine \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Colour code the diagram: Pentose sugar Blue

Hydrogen bonds Yellow

Pyrimidines Green

Purines Red

**DNA quiz**

**(The letter before each clue is the first letter of the answer - write the answer in the space below each clue)**

**A.** The partner organic base to thymine in DNA. (7)

**C.** The partner organic base to guanine. (8)

**D.** Name of the sugar found in DNA. (11)

**D.** Name given to the double stranded, twisted coil of two DNA molecules. (6) (5)

**H.** Type of bonds holding together chains of DNA. (8)

**N.** Charge carried by nucleic acid molecules. (8)

**N.** DNA and RNA are both types of these. (7) (5)

**N.** Each DNA molecule is made up of a chain of these. (11)

**O.** Number of chains of nucleotides making up an RNA molecule. (3)

**P.** Types of organic base made up of two rings of carbon and nitrogen atoms. (7)

**P.** Types of organic base made up of a single ring of carbon and nitrogen atoms. (11)

**R.** Place in the cytoplasm where amino acids are assembled. (9)

**U.** The partner organic base to adenine in RNA. (6)